



Bird Community Monitoring at Arkansas Post National Memorial, Arkansas

Status Report

Natural Resource Data Series NPS/HTLN/NRDS—2011/209



ON THE COVER

Great egret (*Ardea alba*).

Photo taken by Jennifer L. Haack, NPS

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Introduction

Birds are an important component of park ecosystems, as their high body temperature, rapid metabolism, and high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems. It has been suggested that management activities aimed at preserving habitat for bird populations, such as for neotropical migrants, can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991, Maurer 1993). Moreover, birds have a tremendous following among the public and many parks provide information on the status and trends of birds through their interpretive programs.

We use trends in the composition and abundance of bird populations as long-term indicators of ecosystem integrity in the varied habitats of Arkansas Post National Memorial, Arkansas (ARPO). Ecosystem integrity is defined as the system's capability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region (Karr and Dudley 1981). Research has demonstrated that birds serve as good indicators of changes in ecosystems (Cairns et al. 2004, Mallory et al. 2006, Wood et al. 2006).

Therefore, changes in the population size and community composition of birds on the park may reflect the effectiveness of management in restoring and maintaining the various vegetative communities at ARPO. Long-term trends in community composition and abundance of breeding bird populations provide one measure for assessing the ecological integrity and sustainability of these systems.

Methods

Site Selection for Bird Plots

Permanent monitoring locations or 'plots' were selected by overlaying a systematic grid of 200 x 200 meter cells (originating from a random start point). The orientation of the grid was rotated 45 degrees to prevent monitoring sites from being influenced by man-made features (roads, fences, etc.) located along cardinal directions. We established 36 permanent plots on ARPO for monitoring bird population sizes and community composition (Figure 1).

During bird surveys, monitoring plots were located using navigation waypoints (Appendix 1) in a GPS unit and temporarily marked with 36-inch pin flags to aid in re-locating the plots for habitat assessment in years it was taken, eliminating the need for permanent plot markers. We collected pin flags from each plot once the habitat work was completed.

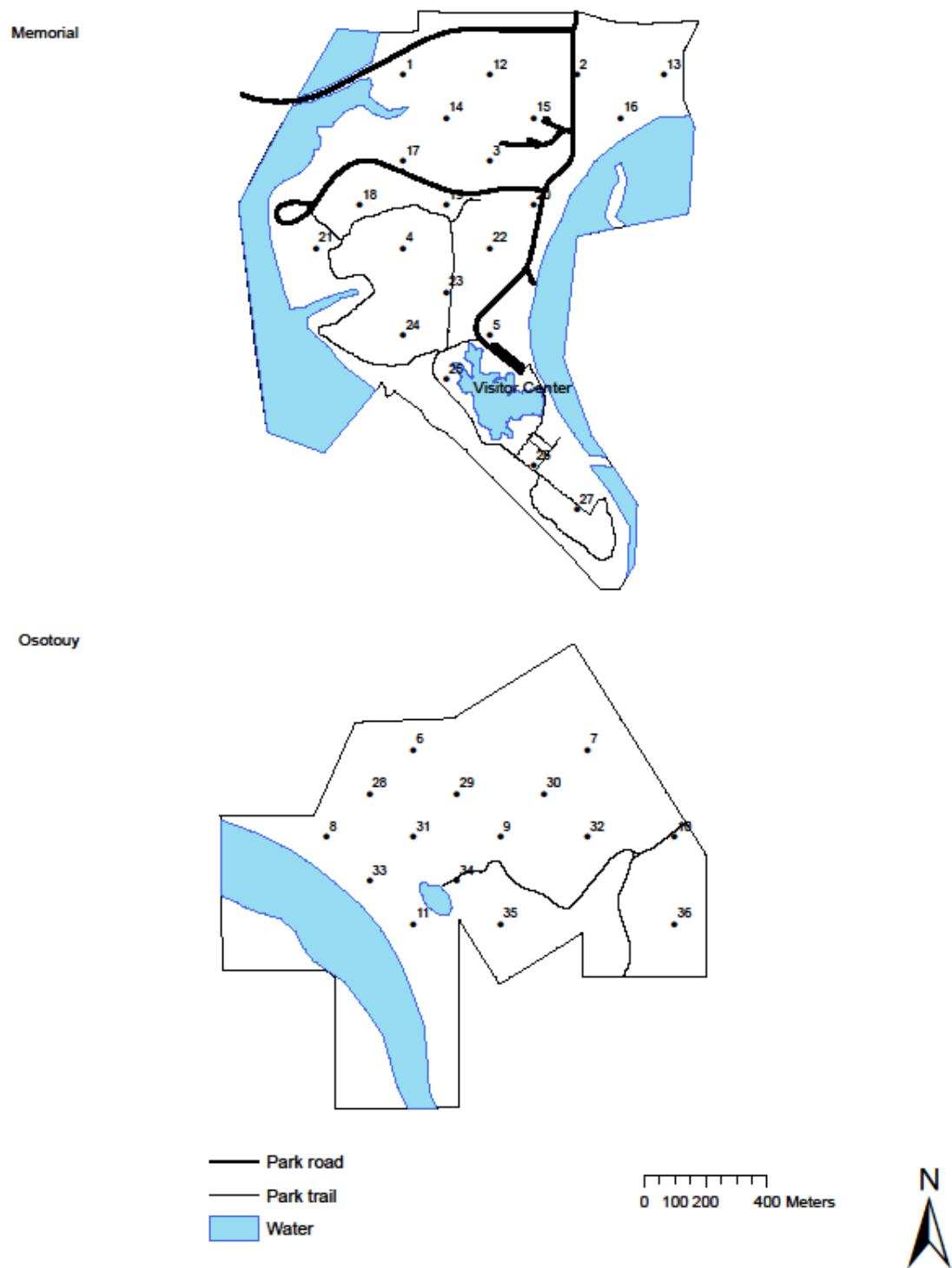


Figure 1. Bird plot locations on the Memorial and Osotouy units of Arkansas Post National Memorial, Arkansas.

Bird Surveys

Bird surveys followed methods outlined in the bird monitoring protocol by Peitz et al. (2008) and summarized below. Variable circular plot counts, a point count methodology that incorporates a measure of detectability into population estimates, were used to survey birds present (Fancy 1997). All birds seen or heard at plots during 5-min sampling periods were counted along with their corresponding distance from observer. Bird observations were separated into two time segments: those detected during the first three minutes of the count (to allow future comparisons with the national Breeding Bird Survey data), and any new birds detected during the final two minutes of the count. For most species, we recorded each individual bird as a separate observation. For species that usually occur in clusters or flocks, the units recorded were cluster or flock size, and not the individual bird. During analysis, each individual in a cluster or flock was treated as separate observations. After completing a count at a plot, and filling out the data sheet, the observer(s) navigated to the next plot using a GPS unit. While traveling between plots, the observer(s) was vigilant for the presence of species not recorded during timed surveys. These species help formulate a more complete species list for the park by identifying species missed during timed surveys. We sampled birds during a period when it was light enough to observe birds to four hours after sunrise. Table 1 listed the number plots sampled each year and sampling dates.

Table 1. Number of plots sampled, and sampling dates for breeding bird surveys conducted at Arkansas Post National Memorial, Arkansas, by year. Also listed are observer(s) who conducted the surveys and whether or not habitat data was collected during the survey year.

Year	Sampling Dates	Number of Plots Sampled	Observer(s)	Habitat Data Collected
2007	June 5 – June 7	36	D.G. Peitz*	Yes
2010	May 12 – May 19	36	Kirby N. McCallie, Jason B. McCallie, Jason A. Allely, Sarah T. Allely	No
2011	June 7 – June 8	27	D.G. Peitz*	Yes

*Heartland I&M Network staff.

Bird Habitat

The collection of habitat data in 2007 and 2011 followed methods outlined in the bird monitoring protocol by Peitz et al. (2008). A summary of the sampling methods follows. Habitat data collection started after the first variable circular plot count was completed. Observers visited plots for habitat measures in the same order they were surveyed for birds to avoid disturbing birds on a plot prior to the survey. Once the habitat crew arrived at a plot, they set up the center subplot and completed all habitat measures for this subplot and the 50-m radius plot.

We characterized habitat available for each bird species on a number of different scales. Slope, slope variability, aspect, aspect variability, and topographic position of each 50-m radius plot were determined and recorded first. Measurements were recorded during this first year of monitoring, and will not be re-measured in subsequent years. The amount of various vegetation types (field/prairie, lawn, roads/trail, shrubland, stream/pond, wooded swamp, or woodland) and the amount of road and water cover on each plot sampled were recorded. As plots were sampled, horizontal vegetation cover was estimated in 0.50-m (2007) or 0.25-m (2011) intervals from 0.0 to 2.0 meters above ground surface using a 0.15-m wide cover board. Area of the cover board obscured by vegetation was estimated at 15-m distances from plot center. Using a graduated

measuring rod, vertical vegetation structure was measured in 1-m increments up to 7.5 meters in height at four locations around the perimeter of the subplot. Locations were in the four cardinal directions. Vertical structure was recorded for deciduous and herbaceous vegetation. Trees were tallied by species and size class (<1.0 cm, 1.1 – 2.5 cm, 2.6 – 8.0 cm, 8.1 – 15.0 cm, 15.1 – 23.0 cm, 23.1 – 38.0 or >38.0 cm) on the subplot. Lastly, at the subplot, ground and foliar cover were recorded in a 1.78-m radius nested sample plot. Ground cover included deciduous and grass litter, bare soil, rock, woody debris (>2.5 cm diameter), and unvegetated. Foliar cover was estimated for six plant guilds, including warm- and cool-season grasses, forbs, moss and lichens, shrubs and vines, tree seedlings, and total foliar cover (<1.5 m tall). Average parameter values were reported for the Monument.

Data Analysis

Prior to summary analysis, the residency status (permanent resident, summer resident, migrant, species out of their normal range, and winter resident) of each bird species recorded was determined. Identifying the residency of each species helps to exclude migrants, species out of their normal range, and winter residents from analysis of breeding birds within ARPO. Hereafter, permanent and summer resident birds are referred to as breeding species. The frequency and abundance of breeding bird species were determined two ways. First, for each breeding species, the number of individuals encountered per plot visit was determined (individuals / plot visit). And second, the proportion of plots occupied by each breeding species was determined (total number of plots occupied by a species / total number of plots visited).

Location and permanent abiotic measures on each plot and habitat subplot were determined. Averages (\pm std dev) for semi-permanent plot data, including road and water cover were calculated from plot estimates. Using plot values, averages (\pm std dev) for horizontal vegetation cover between 0 – 0.25, 0.25-0.5, 0.5 – 0.75, 0.75-1.0, 1.0 – 1.25, 1.25-1.5, 1.5 – 1.75, and 1.75 – 2.0 meters were calculated. Average (\pm std dev) vertical structure diversity was estimated and reported as well.

$$\text{Structural Diversity Index} = \frac{((\sum p_i / 8) + a) * 100}{2}$$

Where p_i – is the observed frequency for vegetation in the i th interval touching a measuring rod out of eight measuring events, and a – is the percent of intervals with recorded vegetation in eight height increments. Vertical structure diversity values are weighted equally to represent both the vertical height of vegetation and how dense the vegetation is within each height increment.

Within each habitat, ground cover, including deciduous and grass litter, bare soil, rock, woody debris (>2.5 cm DBH), and unvegetated were averaged (\pm std dev) across plots. Foliar cover, by guild of warm- and cool-season grasses, forbs, mosses and lichens, shrubs and vines, tree seedlings and total foliar cover (<1.5 m tall) were averaged (\pm std dev) across plots as well. Also reported were species composition and size classes of trees.

Results

Bird Surveys

Thirty-six plots were sampled on ARPO during the breeding bird season of 2007 and 2010. However, flooding reduced the number of plots accessible for sampling to 27 in 2011. Sixty-six bird species were recorded during breeding bird surveys (Table 2). Thirty-three of the 66 species recorded are classified as permanent residents to the area (Stokes and Stokes 1996). Twenty-nine species are classified as summer residents. Two species, House Wren (*Troglodytes aedon*) and Least Flycatcher (*Empidonax minimus*) are classified as migrants through the area. The remaining two species, Canada Goose (*Branta canadensis*) and Song Sparrow (*Melospiza melodia*) are classified as winter residents to the area.

On ARPO, sixteen species--Acadian Flycatcher (*Empidonax virescens*), Bachman's Sparrow (*Aimophila aestivalis*), Brown Thrasher (*Toxostoma rufum*), Carolina Wren (*Thryothorus ludovicianus*), Dickcissel (*Spiza americana*), Eastern Towhee (*Pipilo erythrophthalmus*), Grasshopper Sparrow (*Ammodramus savannarum*), Indigo Bunting (*Passerina cyanea*), Kentucky Warbler (*Oporornis formosus*), Mississippi Kite (*Ictinia mississippiensis*), Prothonotary Warbler (*Protonotaria citrea*), Red-bellied Woodpecker (*Melanerpes carolinus*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), White-eyed Vireo (*Vireo griseus*), Wood Thrush (*Hylocichla mustelina*), and Yellow-throated Vireo (*Vireo flavifrons*)--are considered species of continental importance (Rich et al. 2004). Northern Cardinal (*Cardinalis cardinalis*), Indigo Bunting, and Eastern Wood-pewee (*Contopus virens*) are the most commonly encountered and widely distributed species on the Memorial, annually (Table 2).

Table 2. Bird species recorded during breeding bird surveys at Arkansas Post National Memorial, Arkansas in 2007, 2010, and 2011. Residency status of each species is given.

Common name	Species name	AOU code	Residency ¹
Acadian Flycatcher	<i>Empidonax virescens</i>	ACFL	SR
American Crow	<i>Corvus brachyrhynchos</i>	AMCR	R
American Redstart	<i>Setophaga ruticilla</i>	AMRE	SR
Anhinga*	<i>Anhinga anhinga</i>	ANHI	SR
Bachman's Sparrow	<i>Aimophila aestivalis</i>	BACS	R
Black-crowned Night-heron	<i>Nycticorax nycticorax</i>	BCNH	SR
Baltimore Oriole	<i>Icterus galbula</i>	BAOR	SR
Barred Owl	<i>Strix varia</i>	BDOW	R
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	BGGN	SR
Blue Jay	<i>Cyanocitta cristata</i>	BLJA	R
Brown-headed Cowbird	<i>Molothrus ater</i>	BHCO	R
Brown Thrasher	<i>Toxostoma rufum</i>	BRTH	R
Carolina Chickadee	<i>Parus carolinensis</i>	CACH	R
Canada Goose	<i>Branta canadensis</i>	CAGO	WR
Carolina Wren	<i>Thryothorus ludovicianus</i>	CARW	R
Chipping Sparrow	<i>Spizella passerina</i>	CHSP	R
Common Grackle	<i>Quiscalus quiscula</i>	COGR	R
Common Moorhen	<i>Gallinula chloropus</i>	COMO	SR
Common Yellowthroat	<i>Geothlypis trichas</i>	COYE	SR
Dickcissel	<i>Spiza americana</i>	DICK	SR
Downy Woodpecker	<i>Picoides pubescens</i>	DOWO	R
Eastern Bluebird	<i>Sialia sialis</i>	EABL	R
Eastern Kingbird	<i>Tyrannus tyrannus</i>	EAKI	SR
Eastern Meadowlark	<i>Sturnella magna</i>	EAME	R
Eastern Towhee	<i>Pipilo erythrophthalmus</i>	EATO	R
Eastern Wood-pewee	<i>Contopus virens</i>	EAWP	SR
(Eastern) Tufted Titmouse	<i>Parus bicolor</i>	ETTI	R
European Starling	<i>Sturnus vulgaris</i>	EUST	R
Fish Crow	<i>Corvus ossifragus</i>	FICR	SR
Great Blue Heron	<i>Ardea herodias</i>	GBHE	R
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	GCFL	SR
Great Egret	<i>Ardea alba</i>	GREG	SR
Grasshopper Sparrow*	<i>Ammodramus savannarum</i>	GRSP	R
Hairy Woodpecker	<i>Picoides villosus</i>	HAWO	R
House Wren	<i>Troglodytes aedon</i>	HOWR	M
Indigo Bunting	<i>Passerina cyanea</i>	INBU	SR
Kentucky Warbler	<i>Oporornis formosus</i>	KEWA	SR
Killdeer	<i>Charadrius vociferous</i>	KILL	R
Least Flycatcher	<i>Empidonax minimus</i>	LEFL	M
Loggerhead Shrike	<i>Lanius Ludovicianus</i>	LOSH	R
Mississippi Kite	<i>Ictinia mississippiensis</i>	MIKI	SR
Mourning Dove	<i>Zenaida macroura</i>	MODO	R
Northern Bobwhite	<i>Colinus virginianus</i>	NOBO	R

Table 2. Bird species recorded during breeding bird surveys at Arkansas Post National Memorial, Arkansas in 2007, 2010, and 2011. Residency status of each species is given (continued).

Common name	Species name	AOU code	Residency ¹
Northern Cardinal	<i>Cardinalis cardinalis</i>	NOCA	R
Northern Mockingbird	<i>Mimus polyglottos</i>	NOMO	R
Northern Parula	<i>Parula americana</i>	NOPA	SR
Orchard Oriole	<i>Icterus spurius</i>	OROR	SR
Pileated Woodpecker	<i>Dryocopus pileatus</i>	PIWO	R
Prothonotary Warbler	<i>Protonotaria citrea</i>	PROW	SR
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	RBWO	R
Red-eyed Vireo	<i>Vireo olivaceus</i>	REVI	SR
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	RHWO	R
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RTHA	R
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	RTHU	SR
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	RWBL	R
Song Sparrow	<i>Melospiza melodia</i>	SOSP	WR
Summer Tanager	<i>Piranga rubra</i>	SUTA	SR
White-breasted Nuthatch	<i>Sitta carolinensis</i>	WBNU	R
White-eyed Vireo	<i>Vireo griseus</i>	WEVI	SR
Wild Turkey	<i>Meleagris gallopavo</i>	WITU	R
Wood Duck	<i>Aix sponsa</i>	WODU	R
Wood Thrush	<i>Hylocichla mustelina</i>	WOTH	SR
Yellow-breasted Chat	<i>Icteria virens</i>	YBCH	SR
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	YBCU	SR
Yellow-throated Vireo	<i>Vireo flavifrons</i>	YTVI	SR
Yellow Warbler	<i>Dendroica petechia</i>	YWAR	SR

* Species recorded only while traveling between survey points or at other times outside of 5-min survey periods.

¹ Residency status: SR = summer resident; R = year around resident; WR = winter resident; M = late season migrant. According to Stokes and Stokes (1996).

Species names are valid and verified names taken from ITIS (Integrated Taxonomic Information System). <http://www.itis.usda.gov/>.

Bolded species names are those species considered of continental importance (Rich et al. 2004).

Table 3. Number of individuals encountered per plot visit, and proportion of plots occupied for breeding bird species recorded at Arkansas Post National Memorial, Arkansas during the 2007, 2010, and 2011 breeding bird surveys. Number of individuals encountered per plot visit includes all individuals recorded on plots during a 5-min survey, including flyovers.

Common name	Individuals / plot visit			Proportion of plots occupied		
	2007 (n=36)	2010 (n=36)	2011 (n=27)	2007 (n=36)	2010 (n=36)	2011 (n=27)
Acadian Flycatcher	0.36	--	0.48	0.33	--	0.41
American Crow	0.06	0.17	--	0.06	0.11	--
American Redstart	0.03	--	0.15	0.03	--	0.15
Bachman's Sparrow	0.03	--	--	0.03	--	--
Black-crowned Night-heron	0.03	--	--	0.03	--	--
Baltimore Oriole	--	0.06	--	--	0.06	--
Barred Owl	--	--	0.04	--	--	0.04
Blue-gray Gnatcatcher	0.36	0.17	0.37	0.28	0.08	0.26
Blue Jay	0.11	0.06	0.07	0.11	0.06	0.07
Brown-headed Cowbird	0.14	0.39	0.85	0.08	0.22	0.30
Brown Thrasher	--	0.06	--	--	0.06	--
Carolina Chickadee	0.17	--	0.04	0.17	--	0.04
Carolina Wren	0.11	0.03	0.37	0.11	0.03	0.30
Chipping Sparrow	--	0.25	--	--	0.14	--
Common Grackle	--	0.64	0.19	--	0.14	0.04
Common Moorhen	0.06	--	--	0.06	--	--
Common Yellowthroat	0.03	0.06	--	0.03	0.06	--
Dickcissel	0.28	0.11	--	0.14	0.06	--
Downy Woodpecker	--	--	0.07	--	--	0.07
Eastern Bluebird	0.06	--	0.04	0.06	--	0.04
Eastern Kingbird	0.08	--	--	0.06	--	--
Eastern Meadowlark	0.06	--	--	0.03	--	--
Eastern Towhee	0.06	--	0.04	0.06	--	0.04
Eastern Wood-pewee	0.36	--	0.52	0.33	--	0.48
(Eastern) Tufted Titmouse	0.25	0.08	0.33	0.22	0.06	0.33
European Starling	--	0.03	--	--	0.03	--
Fish Crow	--	--	0.15	--	--	0.11
Great Blue Heron	--	0.06	0.04	--	0.06	0.04
Great Crested Flycatcher	0.08	--	0.11	0.08	--	0.11
Great Egret	0.06	0.19	0.19	0.06	0.17	0.11
Hairy Woodpecker	0.06	--	0.07	0.03	--	0.07
Indigo Bunting	0.44	0.36	0.41	0.28	0.28	0.26
Kentucky Warbler	0.06	--	0.15	0.06	--	0.15
Killdeer	--	--	0.04	--	--	0.04
Loggerhead Shrike	--	0.03	--	--	0.03	--
Mississippi Kite	--	0.03	--	--	0.03	--
Mourning Dove	0.25	0.14	0.07	0.17	0.11	0.07
Northern Bobwhite	--	--	0.04	--	--	0.04
Northern Cardinal	0.89	0.31	0.89	0.61	0.17	0.52

Table 3. Number of individuals encountered per plot visit, and proportion of plots occupied for breeding bird species recorded at Arkansas Post National Memorial, Arkansas during the 2007, 2010, and 2011 breeding bird surveys. Number of individuals encountered per plot visit includes all individuals recorded on plots during a 5-min survey, including flyovers (continued).

Common name	Individuals / plot visit			Proportion of plots occupied		
	2007 (n=36)	2010 (n=36)	2011 (n=27)	2007 (n=36)	2010 (n=36)	2011 (n=27)
Northern Mockingbird	0.36	0.08	0.15	0.31	0.08	0.11
Northern Parula	0.19	--	--	0.19	--	--
Orchard Oriole	0.03	--	0.07	0.03	--	0.07
Pileated Woodpecker	0.06	0.03	0.30	0.06	0.03	0.26
Prothonotary Warbler	0.08	--	--	0.08	--	--
Red-bellied Woodpecker	0.36	0.17	0.30	0.33	0.11	0.26
Red-eyed Vireo	0.03	--	0.04	0.03	--	0.04
Red-headed Woodpecker	--	--	0.04	--	--	0.04
Red-tailed Hawk	--	0.03	--	--	0.03	--
Ruby-throated Hummingbird	--	0.17	0.07	--	0.14	0.07
Red-winged Blackbird	0.31	1.00	--	0.17	0.31	--
Summer Tanager	0.33	0.03	0.11	0.28	0.03	0.11
White-breasted Nuthatch	--	--	0.04	--	--	0.04
White-eyed Vireo	0.06	--	0.04	0.06	--	0.04
Wild Turkey	--	--	0.04	--	--	0.04
Wood Duck	--	0.11	--	--	0.06	--
Wood Thrush	--	--	0.07	--	--	0.07
Yellow-breasted Chat	0.19	--	--	0.19	--	--
Yellow-billed Cuckoo	0.36	--	0.37	0.33	--	0.33
Yellow-throated Vireo	0.17	--	0.04	0.17	--	0.04
Yellow Warbler	--	--	0.07	--	--	0.07

Bolded species names are those species considered of continental importance (Rich et al. 2004).

Bird Habitat

Abiotic features of plots sampled for breeding birds and habitat composition are given in Table 4. Slope and aspect variability were low for the majority of plots sampled. Plots were generally located on level topographic positions, with only four plots located in shallow draws. Slope across all survey plots was low, 4° or less, with one exception.

In 2007, plots surveyed for birds average over 52% woodland habitat type and 20% field / prairie habitat type, with smaller amounts of several other habitat types present (Table 5). During the reduced sampling year of 2011, plots surveyed for birds average over 74% woodland habitat type and 11% field / prairie habitat type, again with smaller amounts of several other habitat types present. Canopy cover averaged over 63% on plots in 2007 and 75% on plots in 2011, with most being from hardwood trees. Basal area from hardwood trees averaged almost 13 m²/ha in 2007 and 22 m²/ha in 2011. Hardwood tree species from seventeen different families contributed to the canopy cover and basal area (Figure 2). Tree species from the family *Cupressaceae* account for the limited amount of conifer canopy cover and basal area recorded.

Horizontal vegetation cover averaged 26% or better for all profile classes. Vertical structure diversity estimates averaged 22% on plots sampled in 2007 and 18% on plots in 2011. Deciduous litter was the most prominent litter type, with lesser amounts of grass litter. Ground cover was mostly unvegetated and bare soil in both 2007 and 2011. Forbs, cool-season grasses, and woody shrubs and vines provided the greatest amount of live foliar cover. Total foliar coverage averaged 35% across plots in 2007 and 29% in 2011.

Table 4. Abiotic features of 50-m radius plots sampled for breeding birds at Arkansas Post National Memorial, Arkansas.

Plot number	Slope (°)	Slope variability	Aspect (°)	Aspect variability	Topographic position	Habitat type
ARPOTweety1	2.5	Low	246	Low	Level	Woodland
ARPOTweety2	0.5	Low	176	Low	Level	Woodland / Edge
ARPOTweety3	1.0	Low	168	Low	Level	Woodland
ARPOTweety4	1.5	Low	209	Medium	Level	Woodland
ARPOTweety5	1.0	Medium	51	Medium	Draw	Woodland / Edge
ARPOTweety6	1.5	Low	129	Low	Level	Old Field
ARPOTweety7	3.0	Low	228	Low	Level	Woodland / Edge
ARPOTweety8	0.0	Low	--	Low	Level	Old Field
ARPOTweety9	2.0	Low	267	Low	Level	Woodland / Edge
ARPOTweety10	1.0	Low	120	Medium	Level	Woodland / Edge
ARPOTweety11	1.0	Low	118	Low	Level	Old Field
ARPOTweety12	0.0	Low	--	Low	Level	Woodland
ARPOTweety13	0.0	Low	--	Low	Level	Woodland
ARPOTweety14	0.5	Low	12	Low	Level	Woodland
ARPOTweety15	0.0	Low	--	Low	Level	Woodland / Edge
ARPOTweety16	0.0	Low	--	Low	Level	Woodland
ARPOTweety17	0.0	Low	--	Low	Level	Woodland / Edge
ARPOTweety18	2.0	Low	244	Low	Level	Woodland / Edge
ARPOTweety19	0.5	Low	208	Low	Level	Woodland / Edge
ARPOTweety20	0.0	Low	--	Low	Level	Woodland / Edge
ARPOTweety21	0.0	Low	--	Low	Level	Old Field
ARPOTweety22	1.0	Low	314	Low	Level	Woodland
ARPOTweety23	4.0	Low	123	Low	Level	Woodland / Edge
ARPOTweety24	0.0	Low	--	Low	Level	Woodland
ARPOTweety25	4.0	Low	30	Low	Level	Lawn
ARPOTweety26	0.0	Low	--	Low	Level	Lawn
ARPOTweety27	1.0	Low	90	Low	Level	Woodland / Edge
ARPOTweety28	9.0	Low	75.0	Low	Draw	Riparian
ARPOTweety29	0.0	Low	--	Low	Level	Old Field
ARPOTweety30	3.0	Low	324	Low	Draw	Woodland
ARPOTweety31	1.5	Low	190	Low	Level	Old Field
ARPOTweety32	1.5	Low	226	Low	Level	Woodland / Edge
ARPOTweety33	0.5	Low	120	Low	Level	Old Field
ARPOTweety34	3.0	Low	266	Low	Level	Old Field
ARPOTweety35	1.0	Low	82	Low	Level	Old Field
ARPOTweety36	0.0	Low	--	Low	Draw	Riparian

Table 5. Averages (\pm std dev) for habitat parameters at Arkansas Post National Memorial, Arkansas during the 2007 and 2011 bird breeding seasons. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%).

Habitat Parameter	2007 (n = 36)		2011 (n = 27)	
	Mean	Std dev	Mean	Std dev
50 meter plot coverage				
Woodland (%)	51.94	43.61	74.85	36.40
Woodland Swamp (%)	4.44	19.05	0.00	--
Shrubland (%)	2.71	16.25	0.00	--
Field / Prairie (%)	20.11	37.52	10.72	28.48
Lawn (%)	4.22	17.32	10.48	27.88
Road / Trails (%)	1.00	2.64	2.41	4.70
Pond / Stream (%)	0.19	0.70	0.37	0.96
5 meter subplot				
Canopy cover				
Hardwood (%)	61.84	43.51	75.26	36.24
Conifer (%)	1.48	7.07	5.80	19.71
Total cover (%)	63.32	43.78	80.83	33.69
Canopy Height				
Hardwood (m)	13.07	11.17	20.67	8.53
Conifer (m)	1.51	4.58	1.49	3.78
Basal Area				
Hardwood (m ² /ha)	14.10	12.41	21.85	12.47
Conifer (m ² /ha)	0.56	1.80	1.76	4.03
Horizontal vegetation profile at 15-m				
0.00 – 0.25 m (%)			68.41	37.84
0.00 – 0.50 m (%)	73.33	35.17		
0.25 – 0.50 m (%)			50.24	42.92
0.25 – 0.75 m (%)	65.11	41.67		
0.50 – 0.75 m (%)			29.50	38.61
0.50 – 1.00 m (%)	49.18	42.59		
0.75 – 1.00 m (%)			26.24	36.35
0.75 – 1.25 m (%)	39.40	41.29		
1.00 – 1.25 m (%)			30.04	39.95
1.00 – 1.50 m (%)	38.64	39.86		
1.25 – 1.50 m (%)			30.22	39.21
1.25 – 1.75 m (%)	36.44	40.78		
1.50 – 1.75 m (%)			35.37	39.54
1.50 – 2.00 m (%)	33.90	40.06		
1.75 – 2.00 m (%)			39.13	41.57
Vertical structure diversity (%)	22.29	13.07	18.36	9.14
1.78 meter sample plot coverage				
Deciduous litter (%)	40.15	32.71	54.07	34.37
Conifer litter (%)	0.08	0.50	1.48	7.20
Grass litter (%)	8.83	13.92	9.06	20.24
Bare soil (%)	17.14	18.36	3.80	8.18
Rock (%)	0.17	0.70	0.00	--
Woody debris (%)	0.53	0.92	9.48	11.56
Unvegetated (%)	86.88	8.09	78.80	16.75
Warm-season grass (%)	0.46	0.94	6.96	20.01

Table 5. Averages (\pm std dev) for habitat parameters at Arkansas Post National Memorial, Arkansas during the 2007 and 2011 bird breeding seasons. Within the scale in which habitat parameters are collected, 50-m plot, 5-m subplot, and 1.78-m sample plot, percentages of coverage may not necessarily sum to 100% as values are averaged over mid-point values of cover classes (i.e. class 1 = 0.5%, class 2 = 3.0%, class 3 = 15.0%, class 4 = 37.5%, class 5 = 62.5%, class 6 = 85.0%, and class 7 = 97.5%; continued).

Habitat Parameter	2007		2011	
	Mean	Std dev	Mean	Std dev
Cool-season grass (%)	6.76	12.35	3.50	8.25
Forb (%)	7.00	10.61	1.78	3.94
Moss and lichen (%)	0.17	0.70	0.81	2.90
Woody shrub and vine (%)	6.75	10.99	12.22	18.59
Tree seedling (%)	0.69	2.46	0.94	1.14
Total foliar (%)	35.43	20.10	28.50	26.41

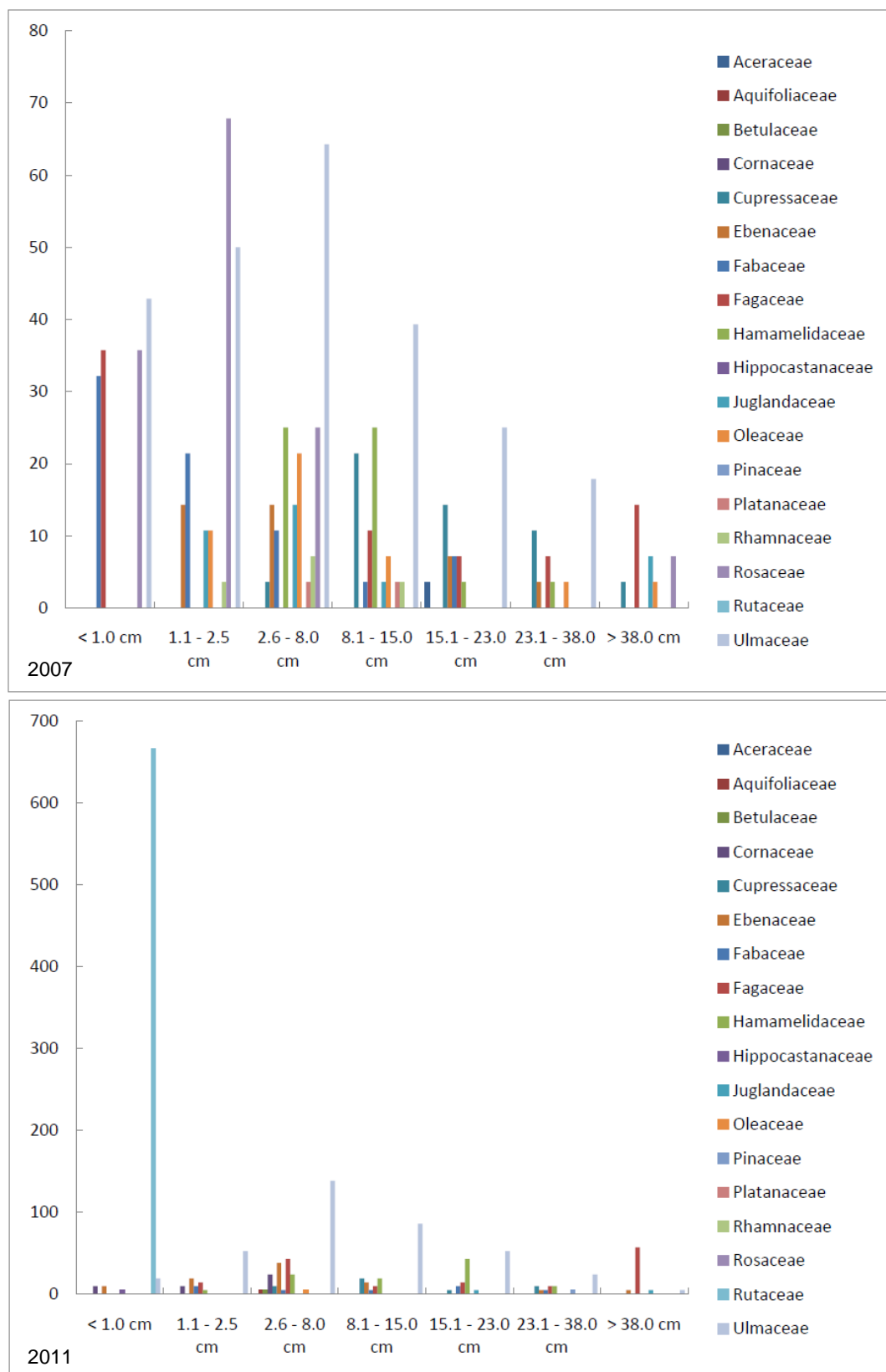


Figure 2. Stems per hectare by size class for tree families recorded on Arkansas Post National Memorial, Arkansas during breeding bird monitoring in 2007 and 2011.

Summary

Bird surveys and habitat assessment work were initiated at Arkansas Post National Memorial, Arkansas in 2007, to assist the park in assessing the ecological integrity of habitat on the Memorial through time. Sixty-two of the 66 bird species recorded are permanent or summer residents to the area (Stokes and Stokes 1996). Current efforts to restore and maintain the mixed habitats at ARPO should provide a diversity of habitats necessary to meet the varied requirements of the 16 breeding species of continental importance observed.

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Appendix

Appendix 1. Plot I.D. and habitat type for each breeding bird survey plot at Arkansas Post National Memorial, Arkansas. Also given are x and y UTM coordinates for each plot, UTM Zone 15 North Datum 1983 (Conus).

Plot I.D	Habitat Type	X Coordinate (Easting)	Y Coordinate (Northing)
ARPOTweety1	Woodland	652413.656	3766221.835
ARPOTweety2	Woodland / Edge	652979.342	3766221.835
ARPOTweety3	Woodland	652696.499	3765938.992
ARPOTweety4	Woodland	652413.656	3765656.149
ARPOTweety5	Woodland / Edge	652696.499	3765373.307
ARPOTweety6	Old Field	660050.410	3761979.194
ARPOTweety7	Woodland / Edge	660616.095	3761979.194
ARPOTweety8	Old Field	659767.567	3761696.351
ARPOTweety9	Woodland / Edge	660333.252	3761696.351
ARPOTweety10	Woodland / Edge	660898.938	3761696.351
ARPOTweety11	Old Field	660050.410	3761413.508
ARPOTweety12	Woodland	652696.499	3766221.835
ARPOTweety13	Woodland	653262.184	3766221.835
ARPOTweety14	Woodland	652555.078	3766080.413
ARPOTweety15	Woodland / Edge	652837.920	3766080.413
ARPOTweety16	Woodland	653120.763	3766080.413
ARPOTweety17	Woodland / Edge	652413.656	3765938.992
ARPOTweety18	Woodland / Edge	652272.235	3765797.571
ARPOTweety19	Woodland / Edge	652555.078	3765797.571
ARPOTweety20	Woodland / Edge	652837.920	3765797.571
ARPOTweety21	Old Field	652130.814	3765656.149
ARPOTweety22	Woodland	652696.499	3765656.149
ARPOTweety23	Woodland / Edge	652555.078	3765514.728
ARPOTweety24	Woodland	652413.656	3765373.307
ARPOTweety25	Lawn	652555.078	3765231.885
ARPOTweety26	Lawn	652837.920	3764949.042
ARPOTweety27	Woodland /Edge	652979.342	3764807.621
ARPOTweety28	Riparian	659908.988	3761837.773
ARPOTweety29	Old Field	660191.831	3761837.773
ARPOTweety30	Woodland	660474.674	3761837.773
ARPOTweety31	Old Field	660050.410	3761696.351
ARPOTweety32	Woodland / Edge	660616.095	3761696.351
ARPOTweety33	Old Field	659908.988	3761554.930
ARPOTweety34	Old Field	660191.831	3761554.930
ARPOTweety35	Old Field	660333.252	3761413.509
ARPOTweety36	Riparian	660898.938	3761413.509